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ABSTRACT

The Minnesota Department of Health developed this guidance at the request of the Minnesota Department of Children, Families and Learning. The goal of the document is to assist school district staff of Minnesota public schools in responding to problems related to indoor mold. Its focus is on practical, cost-effective methods to identify indoor mold problems and assess the causes. A key message of the document is that from a health perspective schools should rarely, if ever, need to have mold testing performed in their initial investigation of a mold problem; rather, the main objective of any mold investigation should be to locate sites of indoor mold growth and determine how to best control the underlying moisture problem and remove the contamination. The document does not provide comprehensive guidance on remediation of severe mold contamination and is not intended to be applied to settings other than Minnesota public schools. The steps described are: (1) contact indoor air quality coordinator; (2) problem background evaluation; (3) investigation; (4) mold cleaning and removal; (5) professional moisture investigation; and (6) professional mold investigation. (Appendices contain the rationale for the recommendations, background on mold and health effects, discussion of personal protection and contaminant control, interpretation of mold testing results, description of expectations for professional mold investigations, mold remediation references, contact information, and a glossary of terms.) (EV)

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ED 462 822

RECOMMENDED BEST PRACTICES FOR MOLD INVESTIGATIONS IN MINNESOTA SCHOOLS

November 2001

MINNESOTA
MDH
DEPARTMENT OF HEALTH

Environmental Health Division
Indoor Air Unit

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EXECUTIVE SUMMARY

Minnesota public schools are increasingly having to respond to the complexities of addressing indoor mold problems and a variety of concerns that have been raised when such problems occur or are suspected. The goal of this document is to assist school district staff in their initial efforts to investigate the causes and severity of such problems for the purpose of finding appropriate cost-effective solutions.

A key message of this document is that from a health perspective schools should rarely, if ever, need to have mold testing performed in their initial investigation of a mold problem. Briefly, the main reasons for this position are that:

- Mold growth simply should not be tolerated in schools -- when such growth is evident, the critical cause (excess moisture) should be corrected and the mold removed as quickly as can be done in a safe and effective manner;
- Mold testing rarely answers the difficult questions school staff struggle with such as, what are the health risks and is evacuation necessary?;
- Such testing often leads to unrealistic expectations that can't be met;
- There are other practical and cost-effective methods for identifying many of the conditions which need intervention; and
- The key to solving a school mold problem will always be to correct the source of excess moisture and remove mold contamination – very often, these can be achieved reasonably well without mold testing.

However, there clearly will be situations where mold testing is valuable or otherwise warranted. For example to "justify" remediation expenditures or protect parties from liability. In addition, properly performed testing may be useful in finding hidden growth or contamination which is not observable. If mold testing is performed, it is critical that the investigation goals are clearly understood, achievable, and focused on solving the problem. MDH recommends that school district staff inform themselves adequately to be active participants in decisions about any mold testing done in their facilities to ensure that results will be useful in correcting the problem.

INTRODUCTION

The Minnesota Department of Health (MDH) developed this guidance at the request of the Minnesota Department of Children, Families and Learning (CFL). The goal of this document is to assist staff of Minnesota public schools in responding to problems related to indoor mold. Its focus is on practical, cost-effective methods to identify indoor mold problems and assess the causes. The main objective of any mold investigation should be to locate sites of indoor mold growth, in order to determine how to best control the underlying moisture problem and remove the contamination.

Mold contamination in the indoor environment is a complex and evolving issue that currently involves a great deal of uncertainty. This guidance is only intended to represent "best practices" advice of a general and conceptual nature for the types of situations many schools in Minnesota have been struggling with recently. When extensive hidden mold growth is present or when problematic contamination has spread beyond the initially identified areas, these guidelines alone may not be sufficient. This document **does not provide comprehensive guidance on remediation of severe mold contamination.** The document is not intended by MDH to be applied to settings other than Minnesota public schools.

There will be instances when mold testing is performed – hopefully for sound reasons. In addition, "investigative" techniques not described in this document may be used to assist remediation efforts. However, it is important for district staff to understand that it is better not to test for mold, unless both sampling and interpretation of the data can be done in a way that meets the investigation objectives with an acceptable degree of certainty.

The procedures on pages 3 through 9 are intended to help district staff perform or oversee an investigation of a suspected mold problem. Steps 1- 3 are actions that can often be done by district staff or with limited resources and outside assistance. The principles in Step 4 and Appendix C may help district staff determine when and if in-house remediation is appropriate or in making sure that outside contractors and consultants meet the district's goals. Steps 5 and 6 describe expectations for professional investigation of indoor mold and its causes.

PROCEDURE FOR SCHOOL DISTRICTS' INITIAL INVESTIGATION OF MOLD

The Minnesota Department of Health (MDH) recommends that school district staff use the following steps (pages 3 to 9) during their initial efforts when responding to a known or suspected mold problem. Each step should be considered in the order presented for applicability to the specific problem situation and circumstances.

Excess moisture is the core underlying cause of any indoor mold problem. **It is critical to address any catastrophic water problem as soon as possible;** drying efforts should begin immediately and materials should be substantially dried within 24 to 48 hours.

STEP ❶ CONTACT INDOOR AIR QUALITY COORDINATOR

All Minnesota public school districts are required to have a person assigned the role of Indoor Air Quality (IAQ) Coordinator. The IAQ Coordinator should be the first point of contact for all complaints or suspicions of mold problems within the district. MDH is available to provide technical advice to the school district if requested by the district's administration.

STEP ❷ PROBLEM BACKGROUND EVALUATION

It is critical in the early stages of a mold investigation that the school district staff remain objective, resisting the temptation to attribute problems and complaints to the most obvious or most easily found explanations.

Follow your district's Indoor Air Quality Management Plan throughout the response. In conformance with the Plan, ask plenty of questions to gather background information[1] on the problem, including such details as:

- ✓ What is the nature of the problem as reported? Is it visible mold, odors, symptoms, or other?
- ✓ Who reported the problem?
- ✓ Where and when has the problem occurred? Include dates and weather conditions.
- ✓ What has been observed by the person(s) reporting the problem?
- ✓ Who else has observed the problem?
- ✓ What symptoms, if any, are reported and by whom? Include timing, location, frequency, severity, and duration.

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[1] School district staff and any contractors/consultants hired by Minnesota public schools should be aware of and follow any applicable legal requirements under the Data Practices Act (Minnesota Statutes, Chapter 13) for information they collect. This statute may require that all information collected during an investigation be made available on request.

Use the information gathered to form an initial assessment of the situation and begin developing hypotheses. Evaluate what is known, and decide what other information may still be needed to understand and resolve the problem. Make certain that the "needs" identified are logical and realistic. **If mold growth is visible and its extent is confidently understood, go to STEP ❹.** Visible mold also indicates the likely presence of other moisture-related biological pollutants such as bacteria and dust mites.

STEP ❸ INVESTIGATION

If the problem's source is not readily observable, yet it makes sense based upon symptoms or history/evidence of excess moisture to suspect mold involvement, district staff should investigate the suspected areas by performing a careful walkthrough. The following activities are recommended.

- ✓ A visual check for mold growth. The appearance of mold may include many textures or colors. Growth may appear as a solid patch or discrete colonies.
- ✓ A visual check for signs of excess moisture or water damage such as leaks, warping, standing water, staining, condensation, efflorescence, corrosion of metal, and dampness to the touch.
- ✓ The use of your sense of smell to locate sources of odors. "Mold odors" are typically described as "earthy" or "musty". Not all mold growth produces noticeable odors and dormant or dead mold will not be odorous. However, when such odors are detected they are a reasonable indicator of mold, bacteria and wetness.
- ✓ Examine or survey suspected areas with a moisture meter to determine locations of elevated moisture within materials or at surfaces in problem areas. Pay attention to colder surfaces, slab floors, hidden spaces, and areas of poor air circulation. Note that a measurement of relative humidity in room air can fail to identify excess moisture because it is not an indicator of the amount of humidity or condensation available to mold growing on a cool surface.

District staff should be able to carry out the early phases of an investigation, but the skills of an indoor air or moisture expert may also be needed in some cases.

Visual inspection and physical assessment should routinely include all areas where moisture sources may be present such as crawl spaces, utility areas, tunnels, and air plenums. In doing so identify and follow safety requirements related to confined spaces. Other areas that should be evaluated include areas with potential water/weather intrusion such as roof, windows, doors, skylights; moisture accumulation on cool condensing surfaces; plumbing; steam pipes, and mechanical air handling and cooling systems.

Moldy environments do not always have visible growth on easy-to-see surfaces. Mold commonly grows hidden within enclosed spaces or other areas that are difficult to view. Consequently, visual inspection and odor assessment may also require careful destructive or

intrusive efforts to inspect areas such as the following[2].

- ✓ Behind, under, and within cabinets, shelving units, storage lockers, and other furniture or furnishings.
- ✓ Under carpet and pad, especially when covering, or installed over, an on-grade or sub-grade slab.
- ✓ Above ceiling tiles.
- ✓ Behind wall coverings such as wallpaper and paneling.
- ✓ Within duct work, chases, risers, tunnels, plenums.
- ✓ Within wall cavities.
- ✓ Inside appliances and mechanical systems.

From a public health perspective, there is no practical reason to test visible mold growth found in a school. Instead, the growth should be promptly removed by cleaning or disposal. However, bulk, contact or tape lift samples may be appropriate in some circumstances, such as when it is "necessary" to verify that a suspected material is mold in order to justify expenditures or corrective steps.

Appendix C contains recommendations and advice regarding the need for personal protective equipment and contaminant control. MDH strongly advises that school districts consider these issues before proceeding with investigation activities that may physically disturb mold growth or other contaminants such as lead and asbestos. If applicable to investigation activities, safety requirements for confined space entry should also be anticipated and must be followed.

STEP ❹ MOLD CLEANING AND REMOVAL

The following is not meant to be a complete discussion of mold remediation. Moreover, no comprehensive consensus guidance currently exists for mold remediation in the industry or scientific community. Appendix F lists several guidance documents which describe mold remediation in more detail.

School district decision makers are urged to consider the potential health threats and the possibility of worsening problems if clean-up of extensive contamination is not properly planned or performed carefully. School districts should use a graded approach calling for greater protective measures with increasing: a) amount of contamination; b) chance that contaminants will be released to the air due to physical disturbance of the growth; and c) likelihood that occupants will come into contact with contaminated surfaces or air. The basis for making such determinations invariably involves professional judgement and requires an understanding of the

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[2] To minimize disturbance of mold colonies and damage to building materials, make small inspection openings and attempt to examine interior spaces using flashlights, dentist's mirrors, boroscope or other techniques. Careful handling implies working slowly and gently to disturb the potentially contaminated materials as little as possible. MDH also recommends using a HEPA vacuum to remove and capture surface contamination as it is encountered.

problem. Appendix C describes some of the most important considerations for protection of occupants and workers and for the control of contaminants.

The school district has the final authority concerning how a mold problem is handled in its facilities. That decision is largely a matter of judgement and depends on many situation-specific factors including budget considerations, potential liability, the perceived nature and extent of the problem, and the skill, experience and level of care that can be expected of those doing the work. MDH strongly recommends that experienced, trained and skilled staff perform the mold removal work when contamination is extensive or beyond the abilities of the district's staff. However, when small amounts of mold growth are found, school staff should be able to remove contamination by carefully and conscientiously applying the following general procedures.

- ✓ Identify source(s) of excess moisture and begin to remove excess moisture as soon as possible, or go to **STEP ❺** if professional assistance is needed.
- ✓ Correct source(s) of, and reasons for, excess moisture. This may be costly and may require system changes and structural repairs.
- ✓ Trap or capture as much surface mold growth as possible from accessible surfaces as soon as visible mold is found:
  - ▸ Vacuum all visible mold growth using a HEPA vacuum; *a shop vacuum is not adequate.*
  - ▸ Carefully and systematically damp clean surfaces to remove and capture surface growth. *Work damp, not wet.*
- ✓ Determine if the material(s) supporting surface mold growth can be cleaned or should be removed and discarded:
  - ▸ Porous[3] materials (including "manufactured" or "processed" wood products) – remove, enclose in plastic sheeting or bag, and discard all porous materials, goods and furnishings which have or had visible mold growth or strong mold odors.
  - ▸ Non-porous materials (including solid wood items) – thoroughly clean all visible growth and soiling from non-porous surfaces which have or had visible mold by scrubbing with an all-purpose cleaner or detergent solution *(for final wiping steps, use clean water).*
- ✓ Expand cleaning to areas and materials in the vicinity of the visible mold growth. This includes areas where it is likely that occupant traffic or activities may have carried contaminants from the primary sites of growth. Use methods that can capture and trap mold particles, such as HEPA vacuuming and damp cleaning *(no*

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[3] Hard surfaced porous materials such as tile, finished wood products, cement, concrete can often be left in place provided that they can be cleaned well, disinfected (optional), and thoroughly dried. If "manufactured" or "processed" wood products and solid wood are structurally sound, would be very difficult to replace and are only lightly contaminated on the surface, thorough cleaning, disinfection, drying and optional sealing may be successful provided the material is kept dry in the future.

sweeping, dry dusting, brushing).

- ✓ Determine if disinfection is needed or desirable. For example, when hard-surfaced porous materials are impractical to replace, such as concrete or cement walls or floors, they should be disinfected with a dilute [5-10%] hypochlorite bleach solution[4] or stronger after cleaning as described above. The solution should be applied by light misting or wiping on to avoid runoff; treat the entire area that supported visible growth. The surfaces should be kept damp with the solution for at least 30 minutes and ideally up to two hours, rinse, then allow to air dry. Since bleach is actually a poor cleaning agent and can be inactivated by organic matter, it is critical to thoroughly clean off visible growth and soiling **before** disinfecting.
- ✓ Allow or facilitate complete drying of all materials wet from excess moisture, cleaning activities, or disinfection solution. Dehumidifiers, fans, and ventilation with dry warm air are among the methods that may be used to speed drying. Complete drying to normal levels may take days or weeks.
- ✓ Perform final inspection for signs of continuing presence of excess moisture and/or return of mold growth before rebuilding or refurnishing. If growth reappears, repeat cleaning steps and disinfect again using a stronger bleach solution and allowing longer contact time. Consider that regrowth may indicate that the material supporting the growth should be removed and/or that excess moisture has not been controlled adequately.
- ✓ Communicate with the public, school staff, and others as specified in the district's Indoor Air Quality Management Plan. Keep all stakeholders informed about findings and progress throughout the investigation and cleanup process.

STEP ❺ PROFESSIONAL MOISTURE INVESTIGATION

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[4] The mixture ratio suggested for initial use is a 20:1 to 10:1 dilution of standard household bleach. One part household bleach in 20 parts water yields roughly a 5% bleach solution (roughly 0.25% hypochlorite solution). One part household bleach in 10 parts water yields roughly a 10% bleach solution (roughly 0.5% hypochlorite solution).

Bleach is a strong oxidizing agent that can corrode, etch or discolor some materials depending on the concentration of the mixture. If harm to surfaces or people is anticipated, other disinfectants may be tried as substitutes.

WARNING: Bleach should never be mixed with any other chemicals unless the product label indicates this is safe. Bleach should never be mixed with any ammonia-containing product because chlorine gas will be produced. Always provide proper ventilation when cleaning or disinfecting agents are handled, mixed or used. Always wear protective gloves when using bleach to avoid skin burns.

Assessment and correction of the source(s) of excess moisture is absolutely critical to solving and attempting to prevent the reoccurrence of an indoor mold problem. A building performance or moisture expert may be needed when moisture problems cannot be identified or resolved by district staff. District staff and the consultant should determine clear objectives for the moisture investigation and ensure that the goals support those of the mold investigation effort. The consultant should be asked to provide the following:

Expectations For Professional Moisture Investigation

- Conduct a thorough walkthrough inspection of the facility/suspected problem area;
- Trace water/moisture pathways to source(s), if possible;
- Conduct moisture testing appropriately;
- Recommend specific actions to correct and prevent moisture problems; and
- Provide a written report or communication to the school district detailing investigation procedure, findings and specific recommendations.

The school district should apply the findings and recommendations from any professional moisture investigation to the clean-up response outlined in **STEP ❹**.

STEP ❺ PROFESSIONAL MOLD INVESTIGATION

From a health perspective, school districts should rarely, if ever, need mold testing in their initial investigation of a mold problem. See Appendix A for further explanation and the rationale for this position. However, testing might be performed for reasons which are not health-based or scientific; for example, to "justify" remediation expenditures or protect parties from future legal liabilities. In addition, if problems consistent with indoor mold persist after the practical measures described in STEPs ❸ and ❹ have been completed, appropriate and properly performed testing may be valuable in finding additional hidden growth or non-visible contamination.

If mold testing is performed, it is critical that the investigation goals are clearly understood, logical and achievable. Testing for mold should not be conducted unless an objective case can be made for it as a necessary part of solving the problem. Experienced and competent investigators should be able to justify any recommended mold sampling with a clear statement of their hypothesis(es) and how the test results will be used in determining solutions to the problem.

School districts that choose mold testing as part of their investigation should refer to the expectations listed below and in Appendix E. Investigators should follow the guidance in Appendix E as they plan and report on their activities in Minnesota public schools, especially if the school district foresees any request to MDH for technical assistance on the situation.

Expectations for Professional Mold Investigation

- Clearly designate and communicate objectives of all investigation activities planned. The primary objectives are to identify/determine:

- excess moisture accumulation and water intrusion;
- the presence of mold growth; and
- the extent of mold contamination.

♦ Gather background information regarding the site and problem history.

♦ Conduct visual assessment of the site and record observations.

♦ Establish, specify and follow sample collection/handling protocols appropriate to meet investigation objectives.

♦ Establish, specify and follow quality control/quality assurance procedures.

♦ Provide results and detailed interpretation.

♦ Provide specific recommendations to:

- correct excess moisture sources and related problems (emphasizing the critical importance of this);
- thoroughly clean and remove mold growth and related contamination; and
- address any other pre-determined objectives.

If mold testing is being considered as part of a school investigation, parties involved in addressing the issue should weigh the pros and cons of testing before mold testing is conducted. District staff should familiarize themselves with Appendices A and C. **Competent investigators are responsible** for assisting the school district's decision makers by: 1) objectively educating them about what they really need from an investigation and how to best achieve it, rather than simply responding to what they ask for; 2) describing the limitations of any testing method, including the serious problem which can occur when too few samples are taken; 3) describing the applicability of test results and the common uncertainties encountered in interpreting results; and 4) managing the common false expectation that mold testing can reliably predict safety concerns or rule out health risks.

APPENDIX A

Rationale for Recommendations

School districts should maintain a focus on solutions when investigating problems related, or potentially related, to indoor mold in their facilities. Efforts should rely mainly on the most practical and cost-effective methods of finding mold growth and moisture problems that need correction. Contrary to popular opinion, mold testing is often unnecessary and there is no practical health-based reason to test visible mold growth once it is found.

While some mold testing may be useful when it is done properly, it should not be done unless performed competently and for the purpose of testing specific hypotheses to aid in solving the problem, such as, locating hidden mold growth or determining the extent of secondary contamination. As a health-protective assumption, MDH suggests that any signs of mold growth in schools be regarded as a potential health hazard which warrants corrective action, regardless of the type of mold or amounts measured. Evidence of active mold growth inside a school indicates that conditions exist which may foster the rapid growth and spread of mold, some of which can be harmful to some people. Testing in a school should not delay prompt corrective actions, nor should it divert resources from the practical solutions of moisture control and thorough cleaning to remove mold contaminants.

The following provide the basis for cautioning against using limited school district resources on indiscriminate, inadequately funded or poorly performed mold testing. In addition, these points underscore the view that mold testing is inherently uncertain and cannot be relied upon to answer questions about health and safety. Finally, the issues described below also illustrate some of the limitations that investigators should be able to address in their sampling plan when they propose mold testing as part of an investigation.

Point 1. The nature and quantity of contaminants present at, and released from, sites of mold growth are typically dynamic and complex. When mold grows and multiplies indoors, the contaminant mixture in the air or even that which is growing on, or deposited on, surfaces can be very expensive to characterize because it may vary over time and space based on the following:

a) Both the types of mold and their absolute and relative numbers in air or on surfaces are likely to vary with an array of potentially changing micro-environmental factors such as temperature, relative humidity, surface water activity level, type of substrate, nutrient availability, presence of competing micro-organisms, amount of light.

b) The amount of mold products released to the air from a site of growth and how they are distributed can change dramatically over short periods of time.

c) The mixture of contaminants in the air can be influenced by factors such as ventilation patterns, air speed and occupant activities, and will change over time and location as the

spores of some species settle out at different rates.

d) The deposition and accumulation of mold particles onto surfaces can depend on releases from growth sites, airborne transport patterns, effectiveness of removal mechanisms and frequency of resuspension caused at least partly by occupant activities such as foot traffic or cleaning.

Point 2. Mold testing is incapable of completely characterizing and measuring the contaminant mixture produced by most indoor mold problems. Because there are fairly reliable, practical and cost-effective investigation techniques which don't require mold testing, the following are reasons to question the usefulness of mold testing in many school situations:

a) Any test method is selective in which molds it can possibly detect out of the broader universe of those molds that may be present -- consequently, testing results cannot be relied upon to give a complete picture of all types of mold present.

b) The quantities of mold detected (both the total numbers and relative frequencies) are not precise counts; that is, the numerical results can vary by the sampling and analytical method used, and should be regarded as fairly crude estimates at best.

c) The results for any particular sample are only applicable to the specific time and location of the sample – test results only represent a "snapshot" in time. They cannot be assumed to estimate the contaminant load at a different location from where the sample was taken and do not necessarily represent past or predict future conditions.

Point 3. It is fundamentally impossible to rule out mold-related health risks by any currently available environmental testing methods. Even if it was practical to collect enough data to identify and quantify all the mold present for a specific time and location, health risks and occupant safety would not be fully understood or predicted due in part to the following:

a) The identity of most mold species, and even strain or isolate, does not adequately predict the amount or types of potentially harmful agents produced. A particular mold that can produce harmful substances does not always do so -- and the types and amounts it produces may change over time and from one location to another.

b) Molds may produce agents which have not yet been identified or are not currently recognized as harmful.

c) Mold testing results alone are not adequate to represent a person's exposure to mold particles or to the mold's harmful products.

d) Much remains unknown about how and why some individuals are affected by mold when others are not, and what factors particular to the agent, the exposure, and/or the person lead to health problems.

e) Numerical criteria are not appropriate for determining if a health concern exists, because there is no agreement on what minimum level of any specific mold, much less a complex mixture of various organisms and their product, is safe or is necessary to cause health effects.

APPENDIX B

Background on Mold and Health Effects

Mold Growth

The term "mold" describes more than a million species of microscopic fungi that grow on wet or damp organic matter, for example, paper, fabric, wood, cellulose-containing materials insulation or ceiling tiles. Several hundred of these organisms may be present in indoor environments. The growth requirements for most indoor molds are relatively simple: oxygen (usually), suitable temperature range, a supply of nutrients, and excess moisture. Moisture is the factor that is most controllable and should be the focus of mold prevention and initial remedial efforts.

Mold grows on surfaces of materials which can provide organic nutrients and where excess moisture is available. A visible growth of mold is called a *colony*. A material which is supporting active growth and proliferation of colonies on its surfaces is called an amplifier. One of the ways that molds reproduce and spread is by specialized microscopic cells called spores. Many spores are very buoyant and readily dispersed by air movement. A single spore or other viable mold particle can rapidly germinate, within days, to form a new colony – which in turn can produce millions of additional spores.

Airborne and deposited mold particles are present throughout the environment – both outdoors and indoors. Except when snow cover is present, molds from the outdoors are readily transported into school facilities as air moves through doors and windows, as people carry mold spores from the outdoors and from other indoor environments on their clothing, foot wear, and on other items that are brought into the school building. Consequently, whenever mold testing is done, some mold is likely to be found; however, the mere detection of mold in an indoor sample does not indicate that problematic indoor mold growth is occurring. Finding indoor mold growth and favorable conditions for mold growth are the real keys to determining if mold problems exist or are likely to occur.

Health Effects of Mold

Many molds can produce a variety of allergenic substances, odorous chemicals, and toxic metabolites. The specific agents produced by mold that can affect human health are not always predictable; they may vary in type, quantity, and strength from species to species and even from one strain or isolate to another of the same mold species. For example, a colony that is producing specific harmful agents at one time might not produce the same agents if the conditions where it is growing change, or if it spreads to a new location with a different set of micro-environmental conditions. The situation is further complicated by the fact that multiple species of mold are often present when an indoor mold problems exists, and each species may be influenced differently from the others as micro-environmental factors change.

In order for mold to affect health, it must contact or enter the body. People are mainly exposed to mold by inhaling spores and by skin/eye contact. Actively growing mold may also release a mixture of various volatile organic chemicals into the air that people breathe.

When people are exposed to high levels of mold, especially when it proliferates indoors, a spectrum of health effects may occur. Allergic symptoms are the most common problems, such as mucous membrane irritation, rhinitis, and rashes. More severe effects, such as asthma attacks, hypersensitivity pneumonitis, infections, or toxic reactions may also occur. However, since susceptibility to the effects of molds varies in the population, health impacts from similar exposures can vary greatly from person to person and may not be readily predictable for some individuals and situations. Persons who are most likely to be susceptible include those with respiratory problems such as allergies or asthma, a compromised immune system, the elderly and the very young. **MDH recommends that anybody who believes they have health problems related to mold should seek professional medical attention**.

Even when an indoor mold problem has been characterized as well as is possible, there will always be uncertainty regarding if or how the health of occupants may be affected. In fact, for a number of practical and logical reasons, the possibility that some portion of any group exposed to molds will suffer adverse health effects can never be ruled out when mold is found growing in occupied areas of a school. Given that there is considerable uncertainty about the health consequences of exposure to contaminants from indoor mold problems, MDH recommends that any mold growing inside a school be regarded as a sign of a potential (current or future) health hazard that should be corrected properly as soon as possible.

APPENDIX C

Personal Protection and Contaminant Control

PERSONAL PROTECTION: When mold contaminated surfaces are physically disturbed, greatly elevated levels of airborne mold particles often result. Such releases can occur during investigation, especially from destructive efforts to get at hidden areas of growth, and clean-up activities. Workers performing such mold related activities may breathe in or their skin may contact mold contaminants. In general, the exposure to a mold worker or other school occupant will likely increase as the amount of mold present increases and the more it is disrupted.

The Indoor Air Quality Coordinator in cooperation with the district's Health and Safety staff, the regional Service Cooperative (formerly, Education Cooperative Service Units) Health and Safety Management Assistance Professionals or the Minnesota Department of Children, Families and Learning should determine what type of personal protective equipment is required[5] for in-house staff and under what circumstances. If district staff are unable to make such a determination, professional assistance should be sought. MDH recommends that workers handling small amounts of moldy materials that are manageable by routine custodial or building maintenance activities on an occasional short-term basis be provided the following types of protective equipment, at a minimum:

- ✓ Respiratory protection capable of filtering particles at least as small as 2 microns in diameter. A NIOSH approved N-95 filtering face piece respirator is recommended at a minimum. A HEPA filtered respirator, for example P-100, is strongly recommended when large areas of contamination are expected to be disturbed.
- ✓ Eye protection; use goggles or respirator which exclude fine dusts.
- ✓ Skin protection; wear disposable or washable outer clothing, long sleeved tops and long pants.
- ✓ Gloves; select those that are impervious to any chemicals used.

CONTAMINANT CONTROL: It is critical, whenever investigation or cleanup activities expose and agitate moldy materials, to control the release and movement of mold particles and any other contaminants that are liberated by the work. Such control is important to protect school occupants from exposure to contaminants that may adversely impact their health and to prevent the spread of contaminants into other areas of the building. Examples of pathways through

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[5] Currently, there are no legal requirements for respiratory protection specific for handling indoor mold contamination in Minnesota. However, when the use of personal protective equipment becomes a requirement, legal requirements for the employer necessarily follow. For example, see CFR 29 1910.134 and 1926.95-107 when respiratory protection is required. For information on statutorily mandated requirements, contact the Minnesota Occupational Safety and Health Administration Workplace Safety Consultation unit at (800)657-3776.

which contaminants are spread from their site of origin include movement via foot traffic leaving the contaminated area, physical movement of improperly encased contaminated materials or by movement through the air.

School district staff should determine the need for contaminant control measures based upon the likelihood that planned activities will disturb and/or disperse large quantities of mold particles in areas where school occupants may be exposed. The following considerations may be useful in evaluating the risks for a particular situation.

Determining the Need for Contaminant Control

- ☐ The amount, density of growth and size of area affected, of visible mold growth and that which may be hidden;
- ☐ The amount of contaminants deposited on surfaces, such as carpet, from past problems;
- ☐ The intensity and duration of physical forces that will be applied to the contaminated materials and the likelihood that this will disturb the mold and release contaminants into the air;
- ☐ The wetness of materials that will be disturbed -- wet materials may produce less dusts than drier materials;
- ☐ The ability to enclose or cover contaminated materials before they are disturbed;
- ☐ The proximity of the contamination to occupants – especially potentially sensitive individuals;
- ☐ The existence of routes for airborne contaminants to reach occupied areas (via planned pathways, such as ductwork, and unplanned pathways, such as an air leakage caused by pressure differences;
- ☐ The length of time before remediation will begin and the expected project duration;
- ☐ The proximity of contamination to items that would be very difficult or costly to clean/remove if they become contaminated; and
- ☐ The skill, experience and level of care that may be expected of those doing the work. MDH strongly recommends that experienced, trained or otherwise skilled staff are used to perform the work when mold contamination is extensive.

The following generalizations are intended to illustrate the two ends of the spectrum of options for contaminant control. In the case of contamination that is limited to small and easily accessible areas and which should be correctable by routine custodial or building maintenance practices, only fairly limited contaminant control measures may be needed. In contrast, more extensive measures are usually warranted when heavy or large scale contamination is expected to become disturbed. While these examples may be used as guidance, specific needs must be determined on a case-by-case basis by the professional judgement of school district staff or their consultants.

In the simpler cases, the following control methods may be used. These are best done before

performing activities that will physically disturb the areas of growth or as contamination is gradually encountered and becomes accessible.

- ✓ Thoroughly vacuum all visible mold and materials surrounding the area of growth using a HEPA vacuum;
- ✓ After vacuuming, damp clean surfaces in the area surrounding the growth;
- ✓ Bag or cover areas of growth with plastic prior to removal of material; and
- ✓ Securely bag waste and dispose.

When contamination is extensive and will likely become airborne, the following methods may also be warranted in addition to those above:

- ✓ Isolate the air handling system from the contaminated/work area;
- ✓ Construct containment[6] around work area using plastic sheeting;
- ✓ Establish negative pressure inside the containment zone using HEPA-filtered ventilation equipment; and
- ✓ Test or monitor containment for leakage.

If district staff desire more detailed guidance on contaminant control, they should refer to one of the documents listed in Appendix F, seek advice from an experienced professional remediation service provider, or contact MDH.

DECONTAMINATION: A protocol for decontaminating workers and equipment should be developed and in place before beginning work that greatly disturbs mold contamination. The level of decontamination needed for a given situation will depend on the nature and amount of contaminants, the type of activities performed, and the use and arrangement of any containment around the work area. For example, when removing personal protective equipment and tools or supplies from an area where elevated airborne mold levels are expected, it is advisable that all such items be decontaminated or bagged for disposal. Hard cleanable surfaces should be HEPA vacuumed and damp cleaned. Clothing should be bagged for disposal or laundering.

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[6] Enclosing mold growth and contaminated materials within permanent structures is NOT recommended -- on its own, this will not control further mold proliferation or degradation of structural materials.

APPENDIX D.

Interpretation of Mold Testing Results

There are inherent problems with measuring the contaminant mixture that results from indoor mold growth. Consequently, considerable uncertainty will exist that must be objectively handled in the reporting and interpretation of any mold testing data. Any use of test results should explicitly acknowledge sources of uncertainty and describe when subjectivity and opinion enter into the interpretation. To maximize the utility of any[7] testing performed to investigating a mold problem in a school, MDH recommends that results be interpreted consistent with the following principles, processes, and caveats.

QUALITATIVE ANALYSIS

The essence of qualitative analysis is to compare the types of mold species detected in an area of interest, area of concern, against those detected in a comparable sample from an appropriate control[8] area which is not expected to have problematic levels of mold. When the types of mold and relative proportion for each type differ significantly from those of the "control" sample, an area of indoor mold growth (fungal amplifier) is suspected as the source of the additional organisms.

COMPARISON TO OUTDOOR CONTROL SAMPLE -- If mold species are found at greater than one or two colony forming units in an indoor sample[9] which are not present in the outdoor control samples, this suggests an indoor source of mold growth. Note that normally at least two outdoor control samples are recommended.

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[7] Bulk, contact, or tease tape samples are sometimes collected for the sole purpose of confirming that a suspect material is mold – these can be of value in an investigation and need only be interpreted as positive or negative for the presence of mold growth structures.

[8] For the purposes of this document, the term "control" is roughly interchangeable with "reference", "comparison", or "background." These terms are used to refer to samples taken from presumably uncontaminated areas. The fungal load of a specific suspect media area and media may be partially assessed through a comparison to that in the uncontaminated area(s). However, for accuracy it is acknowledged that these are not true controls.

[9] Raw values or actual counts of organisms should be considered in the interpretation of the results because the concentration will depend on sampling duration. When raw numbers or actual counts for the sample indicate only one or two spores of a species were detected, these can generally be disregarded unless their presence is confirmed in several other samples. Repeat sampling may also need to be considered under these circumstances.

COMPARISON TO INDOOR CONTROL SAMPLE -- If mold species are found in greater than one or two colony forming units in a sample from an area of concern which are not present in an indoor control/background sample, this suggests an indoor source of mold growth may exist and have contributed contamination above the indoor background levels.

QUANTITATIVE ANALYSIS

Quantitative analysis is based upon the number and concentration of molds found in the study area compared to a comparable sample from appropriate control areas such as indoor control and/or outdoor control locations. The total number of colony forming units and number per unit for each species should be similar to, or less than, that found in the control samples. At the very minimum, 3 control samples should be collected -- 2 or 3 outdoor control samples and 1 indoor control.

COMPARISON TO OUTDOOR CONTROL SAMPLE -- The total number of colony forming units should be less than that found in the outdoor control samples and the percentages of the total sample made up by each species should be similar to that for the same species in the outdoor control samples. If there is a shift in the predominant species in the indoor sample, this indicates an indoor source of mold spores is likely present for those molds which were found in greater relative numbers in the indoor sample than in the outdoor samples. Whether the sampled indoor area(s) are ventilated by mechanical or natural means is another important consideration.

COMPARISON TO INDOOR CONTROL SAMPLE -- The total number of colony forming units should be similar to that found in an indoor control sample and the percentages of the total sample made up by each species should be similar to that for the same species in the indoor control sample.

The degree to which the control samples are appropriate to characterize the "normal" or background level and distribution of mold or the contribution from outdoors air to an indoor location, greatly influences the ability to use the data. Appropriateness can be viewed in terms of the timing, the location, and the number of samples used to characterize the fungal load of a given site. For example, if an indoor area chosen for a control sample also has elevated levels of mold, problems in either the control or suspect area may be masked in the comparison process unless outdoor controls are also available. In addition, when selecting appropriate outdoor control sample time and location for a building that is mechanically ventilated, "hold up time" or the length of time for mold particles to travel from the outdoor intake to the indoor sampling point, should also be considered. As described in Appendix E, mold investigation reports should discuss the basis for selecting control sites and justify their use as an indicator of "normal" or background levels.

The detection of only a few spores or colonies of a particular mold in a sample should only be considered suggestive of an indoor source. In contrast, the confirmed presence of a particular

organism generally requires that: (a) it is found in several samples, (b) it is identified several times in a single sample, or (c) there is visual evidence of or source sampling indicating its growth in the building. When the persistent presence of such organisms has been demonstrated, school districts must make decisions concerning safety on a case-by-case basis. All relevant circumstances must be considered, including any information which may indicate that occupants are, or will likely be, exposed to the mold.

Additional Notes:

Use of numerical guidelines is not recommended. Various guidelines for interpreting mold sampling data have been developed, but scientific consensus suggests that it is overly simplistic and inappropriate to rely solely on a comparison of test results to any numerical criteria. The applicability of any such guidelines should be specific to the media sampled, sampling technique and all parameters, analytical method, growth/culture media, geographic location, and building operation conditions such as natural ventilation versus filtered mechanical ventilation. At this time, MDH regards numerical guidelines for mold as arbitrary and does not support their use as the sole basis for determining if an environment needs to be corrected. Instead, visual evidence and building history should form the initial basis for identifying most school mold problems.

Species-level identification is preferred. Two names are used to describe a specific kind of mold; the first designates the genus and the second denotes the species. As an analogy, genus is comparable to the make of a car and species is the model. If the molds are identified only to genus (species not determined), comparisons of control and non-control samples may fail to detect evidence of problems indicated by differences between species of the same genus. In addition, some of the potential health hazards of molds can differ depending on the species.

Identification of mold to the species level requires culturable sampling techniques which obtain and allow germination and growth of viable mold propagules. Inherent limitations in such methods include the increased time required for sample growth, the inability to detect non-viable mold particles, and the lack of a single sample growth media that allows all species to compete well enough to be identified. Some labs may report species for samples analyzed without culturing the molds, but these should always be viewed as a "presumptive identification" at best.

Because speciation of some genera of molds can be quite costly, it may be preferable when funds are severely limited, to ask if the laboratory will be able to "split" between two species without naming them at no extra charge. In other words, in some cases the lab may be able without much extra effort to distinguish two species as distinctly different. Depending on the species present, this strategy may give enough detail to allow a more meaningful distinction of mold types from one sample to another with less expense.

Identification of "red flag" organisms. Certain species of mold are of particular interest when their presence is confirmed in an indoor location because of their greater potential to cause health effects in some people. Indoor molds commonly considered potentially hazardous include some of the following:

- Species of *Aspergillus (A. fumigatus, A. flavus, A. versicolor)*
- Species of *Fusarium (F. moniliforme, F. solani, F. oxysporum)*
- Species of *Penicillium (P. marneffei, P. chrysogenum, P. camembertii)*
- Species of *Stachybotris (S. chartarum* [also known as *S. atra])*
- *Alternaria alternata*

The above is not a complete list of all molds that are significant to human health. Many other molds can also cause health problems for some occupants under certain conditions. Furthermore, there has been relatively little effort to date directed at identifying and testing the toxicity of the myriad mold metabolites or constituent chemicals that are likely to exist. In other words, despite current knowledge that certain organisms can cause problems for some individuals, the full spectrum of health effects caused by most molds, even common species, is currently unknown.

It is premature given the limited state of current knowledge to conclude that some types of molds are necessarily of less concern from a health risk standpoint than those which have been labeled by the popular media as "hazardous" or "toxic". For this and other reasons, it is not appropriate in the school setting to conduct testing solely for the purpose of attempting to find out if so-called "dangerous" molds are present.

APPENDIX E

Expectations For Professional Mold Investigations

The following is intended to be a suggestion of what school districts should expect and request from consultants who provide mold investigation services, **especially those which propose to perform mold testing** as part of their investigation. The expectations are presented in a format resembling an investigation report. MDH recommends that school districts make these expectations known early, so that activities are planned to ensure the district's needs are met.

INTRODUCTION / BACKGROUND

The purpose of the introduction is to provide sufficient information about the problem to demonstrate that the investigation efforts were warranted, logical, and the objectives were clear. At a minimum, this section should include the following information:

- Description of facility history, any past moisture problems and/or occupant complaints;
- Description of all information provided by the operators/occupants related to the suspected problem or complaints;
- Description of parties involved in the current or previous investigations;
- Description of past issues already identified and how they were addressed;
- Outline of current problem; and
- Clear statement of the hypotheses and goals of the investigation.

SITE VISIT DESCRIPTION

Thorough visual assessment of the site is critical to a well reasoned and logical investigation. Information about the building's history, especially concerning moisture problems and any past or recent mold complaints, should be further evaluated during the inspection. Observations or measurements should be recorded and described in sufficient detail to convey what was done during the inspection and to demonstrate convincingly that the scope of inspection was reasonably adequate to determine: (1) if visible mold colonies were present, (2) if mold odors were detectable, and (3) if signs of current or past excess moisture were visible.

At a minimum, the site visit description should include the following information:

- Identification of persons interviewed or providing information;
- Description of general building condition;
- Identification of specific areas inspected and their normal or intended uses;
- Description of building's mechanical systems, especially those which serve the areas being investigated;
- Documentation of relevant past moisture problems or description of evidence for recent or ongoing excess moisture accumulation or water intrusion such as, high relative humidity measurements especially at cold surfaces, condensation especially on colder surfaces, water content measurements, water stains, decaying or warped wood, failing paint, peeling wall covering, roof leak, plumbing leak,

flooding, lack of conditioning of humid outdoor, leaking windows;
- Description of any identified building system failures associated with the moisture intrusion, excess moisture build up, or high indoor humidity;
- Description of moisture migration pathways traced to sources as best as possible;
- Description of visual observations of potential sources of mold contamination;
- Description of pathways for dissemination of particulate mold contaminants or mold-produced volatile organic chemicals (odors); and
- Documentation of environmental conditions as well as the apparent effectiveness of the HVAC system, such as were all unit-ventilators operational?, was a building designed to have air conditioning and was it operational?

SAMPLING/TESTING

NOTE: IN MOST CASES, MDH DOES NOT RECOMMEND MOLD SAMPLING AS PART OF THE INITIAL EFFORTS TO INVESTIGATE POTENTIAL MOLD PROBLEMS IN SCHOOLS. However, properly conducted testing and the information it can provide when used appropriately may be useful and even necessary at some point in a school district's response to mold contamination issues.

When mold testing is performed, MDH believes that is critical that investigation goals are clearly understood, logical and achievable. Unless there is a clear understanding of how test results will be helpful and how they will be used to assist in correcting the problem, testing is likely to be wasteful of scarce resources or worse yet, misleading. Experienced investigators and competent consultants should be expected to justify any recommendation to collect mold samples and should explain their reasoning and any underlying assumptions or anticipated limitations.

If environmental samples are collected to test for mold, the following minimum information should be provided:
- Discussion of why sampling/testing is being performed. Provision of a clearly identified, specific objective for sampling and how the specific sampling procedure will assist in meeting the objective.
- Description of how the data are to be interpreted and used to meet the objectives.
- Description of how the sampling protocol and choices achieved the objectives:
  - Clear identification of sample locations and reason(s) chosen;
  - Describe each sample collection method[10] and reason(s) chosen;
  - Describe sample media used and reason(s) chosen; and
  - Identify analytical procedures used and reason(s) chosen.

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[10] If culturable bioaerosol sample results are to be interpreted by quantitative comparison, MDH suggests that species level identification permits greater confidence in interpretation (see Appendix D). Note that confident identification of many species requires culturable sample techniques – species identification from countable techniques should be considered "presumptive"at best, or somewhat less than certain.

- Description of QA/QC procedures used:
  - Chain of custody for samples;
  - Sample preservation methods;
  - Date/time of sample analysis;
  - Analytical methods; and
  - Credentials of analyst/lab[11].
- Description of environmental conditions during and prior to sampling:
  - Outdoor weather conditions;
  - Temperature, relative humidity and dew point in the sampled space
  - Occupation of space, type and level of activity;
  - Windows open or closed; and
  - HVAC system isolated or not.

FINDINGS AND INTERPRETATION

All data from sampling efforts should be reported in a clearly labeled format indicating sample collection method, location, time and results. Raw data or actual counts should always be reported. Extrapolated or values normalized to a per sample unit basis can also be given, but these should not be the only data reported. Results from quality control samples should also be presented in the report along with the sampling data. Any laboratory notations relating to samples or calculations performed on the data should also be provided with the sampling results. A fairly complete interpretation of the data should be provided. For any environmental media sampled for investigation purposes, MDH recommends that interpretation be consistent with the principles described in Appendix C. It is also imperative that all limitations or qualifications related to the data be clearly stated and all reasonable explanations or alternate interpretations be objectively presented.

The findings should describe all excess moisture accumulation/water intrusion and mold contamination identified or otherwise known. Where future excess moisture accumulation or water intrusion is obvious or likely, this too should be pointed out. Visual observations of moisture and/or mold contamination should be described along with any building system failures found to be associated with excess moisture or water intrusion.

CONCLUSIONS AND RECOMMENDATIONS

This section should identify the source(s) of excess moisture which has allowed, is allowing, or is likely to permit indoor mold growth. The section should also describe what the observations and sample results objectively demonstrated about the presence of mold growth indoors, the

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[11] It is critical that samples be analyzed by a mycologist competent to provide the level of taxonomic identification needed for the intended uses of the data. When data regarding the types of mold and quantities are to be used in the assessment of the problem, MDH suggests that laboratories used for sample analyses be, at a minimum, accredited or certified by the American Industrial Hygiene Association's EMLAP program described on-line at www.AIHA.org. *Note that being a "participant" in the EMPAT program is not by itself an indication of competence.*

pathways for dissemination of mold particles or mold-produced volatile organic compounds in occupied spaces, and the extent of areas that should be addressed to remove both viable and non-viable mold contaminants.

Conclusions should logically follow from and refer back to the findings, especially the observations reported. If evidence of indoor mold growth was identified, conclusions must address the:

- source(s) of excess moisture that permitted mold growth and
- extent of mold contamination that warrants removal.

Recommendations should be consistent with and responsive to the conclusions. If indoor mold growth was identified, the recommendations must include specific activities or procedures to:

- correct or eliminate source(s) of moisture that supported mold growth;
- remove all visible mold growth and any related contamination as prudent; and
- prevent further excess moisture accumulation or intrusion and/or future mold growth.

APPENDIX F

Mold Remediation References

There exist several mold remediation guidance documents which describe or recommend various control measures based upon the extent or type of mold contamination. Such materials can be used by schools at their discretion if they feel more detailed advice on mold clean-up and removal is needed -- such as when very heavy or widespread contamination is encountered. The following are examples of such resources:

- Mold Remediation in Schools and Commercial Buildings, U.S. EPA Indoor Environments Division. April 2001

- Guidelines on Assessment and Remediation of Fungi in Indoor Environments, New York City Department of Health Bureau of Environmental & Occupational Disease Epidemiology. April 2000.

- Standard and Reference Guide for Professional Water Damage Restoration IICRC S500, The Institute of Inspection, Cleaning and Restoration Certification. Second Edition 1999

APPENDIX G

Minnesota Contact Information

Minnesota Department of Health

Indoor Air Unit
P.O. Box 64975
St. Paul, MN 55164-0975
phone: 651/215-0909 or 800/798-9050

Minnesota Department of Children, Families and Learning

Phil Allmon
Health, Safety/Risk Management Coordinator
phone: 651/582-8748
e-mail: phil.allmon@state.mn.us

Regional Service Cooperatives (formerly, Education Cooperative Service Units)

Regions 1 & 2	North West	Thief River Falls
Region 3	North East	Mountain Iron
Region 4	West Central	Fergus Falls
Region 5	North Central	Staples
Regions 6 & 8	South West	Marshall
Region 7	Central	St. Cloud
Region 9	South Central	Mankato
Region 10	South East	Rochester
Region 11	Metro	Minneapolis

Minnesota Department of Labor and Industry

Minnesota Occupational Safety and Health Administration
Workplace Safety Consultation Unit
800/657-3776

APPENDIX H

Glossary of Terms

AMPLIFIER: *An item (material, substrate, etc.) that supports the active growth and proliferation (increase in numbers) of mold.*

BIOAEROSOL: *Airborne particles or matter of biological origin (derived from a live or formerly living organism). For example, mold spores or fragments of a mold growth which are suspended in the air.*

CLEANING: *The science and practice of controlling contaminants by locating, identifying, containing, removing and disposing of unwanted substances from the environment.*

COLONY: *A uniform mass of cells all derived from a single cell and which is growing on a solid surface. A colony is usually the smallest unit of mold that can be observed with the naked eye.*

CONTAINMENT: *Barriers, seals, air-locks, negative air filtration systems and other methods used to control the movement of airborne materials or agents and avoid secondary contamination. For example, plastic sheeting used to enclose a work area to prevent disturbed mold particles from drifting from the containment zone into adjacent or connected areas.*

DISINFECTION: *The elimination and destruction of microorganisms which may allow for survival of some resistant organisms (e.g., bacterial endospores).*

EFFLORESCENCE: *Formation or presence of white crystalline material deposited on the face of masonry.*

ENCLOSURE: *The practice of attaching a rigid and durable barrier to building components, with all edges sealed for the purpose of permanently enclosing contaminants.*

GENUS: *A biological level of classification directly above the species level. In the practice of naming mold, the genus is indicated first and is capitalized (e.g., <u>Aspergillus</u> is the genus of the mold named, <u>Aspergillus fumigatus</u>). There often are many different species within a single genus.*

GENERA: *the plural form of Genus.*

HEPA: *High efficiency particulate air. Capable of removal and capture of 99.97 % of dispersed particles greater than or equal to 0.3 microns in size.*

HYPERSENSITIVITY PNEUMONITIS: *Abnormal sensitivity of the lungs to certain*

environmental factors.

ISOLATE: *An organism that has been grown from a particular sample.*

METABOLITE: *A chemical produced by the metabolism of a living organism; produced by enzymatic action.*

MICRON: *A unit of measure equal to one millionth (10^{-6}) of a meter; also known as a micrometer and written as "µm".*

MVOCs: *Microbial Volatile Organic Compounds: a group of several organic chemicals that can be produced by actively growing molds and bacteria and which are released as gases into the air.*

MYCOLOGIST: *A person who studies or has "expert" knowledge of fungi.*

MYCOTOXINS: *A broad category of specialized fungal metabolites that can have harmful effects on humans or animals. These are generally associated with the fungus itself, not with the volatile products. Mycotoxins can be present in either living or dead spores or fragments and in the materials on which the mold has grown. Each individual mycotoxin has its own spectrum of potentially harmful effects.*

PATHOGENIC: *Capable of causing disease. The molds most often regarded as pathogenic are those which are most frequently known to cause opportunistic fungal infections, primarily among immune-compromised individuals (e.g., Aspergillus fumigatus).*

POROUS: *Strictly defined, porous refers to the ability of a material to allow fluids to pass through (permeability to liquids or gases). For the purposes of this document, porous materials are items which absorb moisture (liquid water or humidity). Examples include wood products, paper products, fabric, carpet and pad, plasterboard, drywall, insulation, ceiling tiles.... In contrast, non-porous materials include Formica, vinyl, plastic, glass, some tile, metal and many other similar hard surfaced durable or sealed materials.*

PROPAGULE: *Particles that are capable of producing a colony (for example mold spores or fragments of hyphae).*

RELATIVE HUMIDITY (RH): *A ratio demonstrating the actual amount of water present in air: to the maximum amount of water that air (at the same temperature) is capable of holding; this ratio is expressed a percentage. Warmer air has a greater capacity to hold water in the vapor form than does cooler.*

REMEDIATION: *The spectrum of measures intended to correct a problem and restore the environment to a useable state. For the purposes of this document, MDH regards mold remediation as any combination of activities which: a) remove indoor mold growth and mold-*

contaminated materials, b) eliminate and prevent excess moisture that allows growth, and c) rebuild or refurnish. For example, when mold growth that is limited to items that can be cleaned or easily removed, remediation can consist of routine housekeeping and maintenance practices.

SPECIES: *The next most specific level of biological classification below genus. In the practice of naming mold, the species follows the genus and its first letter is always written in the lower case (e.g., fumigatus, in Aspergillus fumigatus).*

SPORE: *A specialized reproductive cell. Mold spores are individually microscopic and many are very buoyant. As such, they readily stay suspended in the air and can be dispersed by air movement.*

STRAIN: *A group of organisms within a species or variety, characterized by some particular quality.*

TAXONOMY: *An orderly system for classifying and naming living organisms based upon how closely groups or individuals are related. See also GENUS and SPECIES.*

TOXIGENIC: *Able to produce toxic substances. For example, some molds are toxigenic (alternate term -- mycotoxigenic) and these may, under certain circumstances, produce mycotoxins. Because toxigenic molds do not always produce toxins, the finding of toxigenic molds in a sample does not necessarily demonstrate that toxins are being produced in the sampled environment.*

VIABLE: *Able to maintain an independent existence. For example, a viable mold spore is capable of reproducing a new colony after germination. Some mold spores can remain viable for many years.*

For more information or to contact the Minnesota Department of Health Indoor Air Unit, please contact 651/215-0909.

To request this document in another format, such as large print, Braille or cassette tape, contact the Minnesota Department of Health Indoor Air Unit at (651)215-0909; TDD (651)215-0707; or toll-free through the Minnesota Relay Service at (800)627-3529.

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